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PLANTING FOREST TREES IN INDIANA

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By
RALPH F. WILCOX
State Forester

THE DEPARTMENT OF CONSERVATION
DIVISION OF FORESTRY
Indianapolis

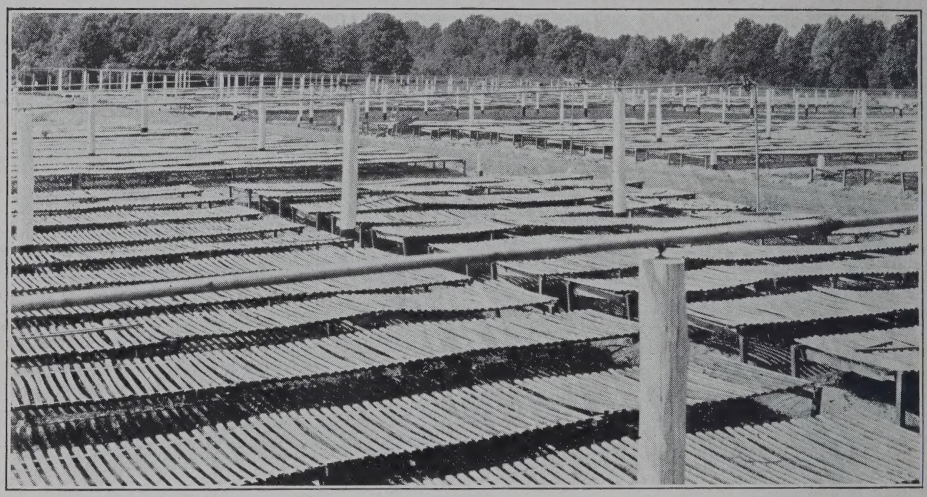

Fig. 1. Photo "a". The State Forest Nursery of Indiana at Henryville. The young seedling trees must receive shade and water. After they are two or three years old they are transplanted once. They are ready for forest planting at the age of three or four years.

Fig. 1. Photo "b". Millions of young forest seedlings and transplants are being grown in the state nurseries. They are distributed at the cost of production, from five to ten dollars a thousand. They must be planted strictly for reforestation. Ornamental trees for lawns, driveways and roadsides should be ordered from the private nurseryman.

THE DEPARTMENT OF CONSERVATION
STATE OF INDIANA

CONSERVATION COMMISSION

STANLEY COULTER, Chairman
EVERETT L. GARDNER
DAVID A. ROTHROCK
MARTIN R. GOSHORN

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Planting Forest Trees in Indiana

WHY WE SHOULD PLANT FOREST TREES

WOODLOT REINFORCEMENT

Our fine hardwood forests have been repeatedly culled over for the more desirable species such as white and red oak, tulip, white ash, and black walnut. Many of our formerly fine woods have deteriorated to derelict overmature trees of the less desirable species such as beech, elm, maple, hickory, and black oak. These inferior trees should be cut for lumber or fuel to liberate the natural reproduction of the more desirable species where such young growth is present.

No systematic effort has been made to keep up the breed in our forests. If natural seedlings of the better kinds of trees are missing, due to fire, grazing, and an absence of seed trees, they should be planted artificially to secure a stand of the best trees for every forest.

WASTE LAND

It is estimated that there are 1,000,000 acres of farmed-out, eroded, hilly, or otherwise idle land in Indiana. The first step on such land was to remove the valuable virgin timber crop. The next step has been to lose soil fertility by poor farming and erosion. The areas yield little or no annual revenue and are abandoned to weeds and erosion. When the time comes to rebuild houses, barns, and fences there is no ready source of revenue such as a good forest to afford the necessary replacement.

Certain southern Indiana counties have the bulk of this land. It is an economic zero to the local community, state, and nation from the standpoint of producing revenue. As a rule it is no longer suitable for anything but growing trees. Where natural regeneration has failed to reforest these old fields artificial forests must be established by planting. This is a forestry problem for the state and for the private individual who owns the land.

Many of our really valuable farms throughout Indiana have a few acres of land on which argricultural crops are not profitable to grow. It may be low land, subject to overflow, or fields which are to distant or too small to fence and cultivate.

The Department of Conservation believes that every farm should have a few acres of woods on it regardless of the value of the land for agriculture. Beyond this extent valuable agricultural land should not be planted to forest trees. Forestry offers a means by which every acre in Indiana could be a producing acre.

THE FOREST CROP

The forest crop is a long time savings account. Every year the trees grow an interest on the original tree investment. Farm crops,

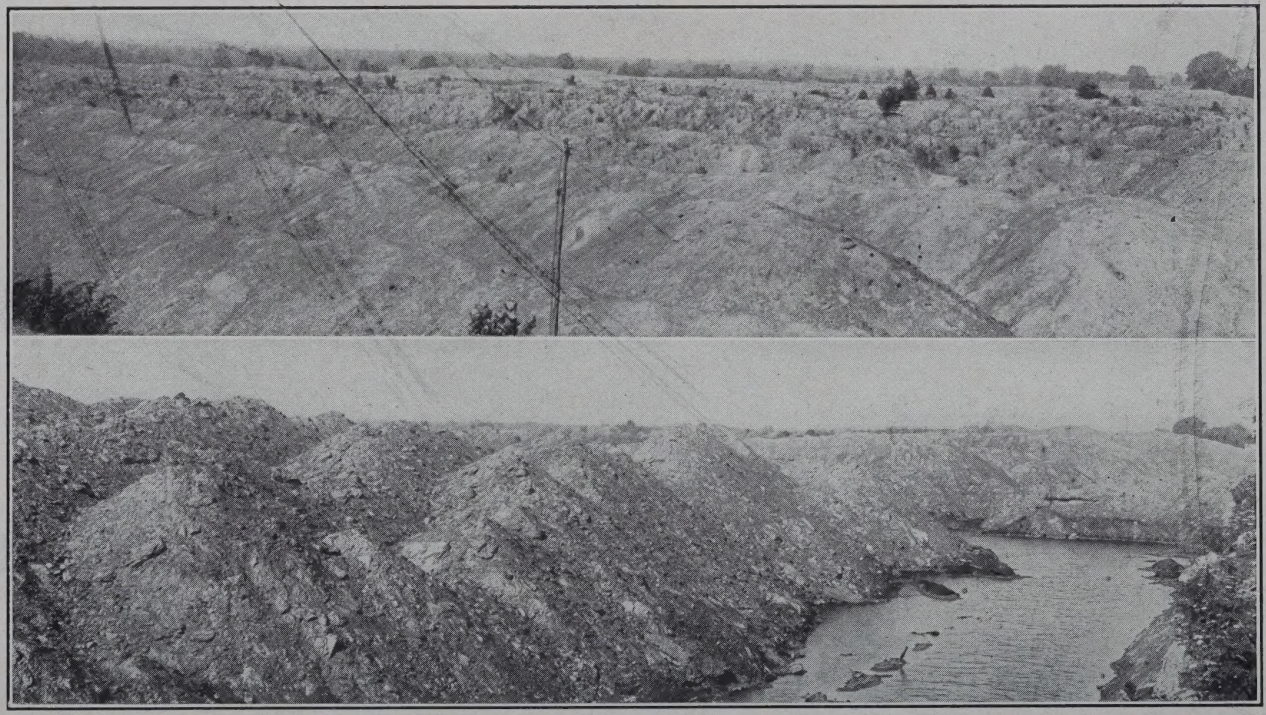

Fig. 2. Stripped-over coal land in Pike County. These hundreds of acres of ruined farm land decrease the value of adjacent property. Tree planting will clothe them with green forests and restore the land to productivity. A half-million trees will be planted each year by the coal companies as soon as the seedlings can be grown in the state nursery.

grazing, and other agricultural activities have unprofitable years, which sometimes occur in cycles of several years' duration. They involve a high investment every year of labor and capital while the forest grows with little care.

The forest income is comparatively small each year but certain. Work in the woods can be done during the winter months when farm labor is more plentiful and otherwise might be idle. The annual revenue by growth accumulates until the day of tree maturity when it can be used as a gross sum to replace buildings and fences, or sold to replace other investments on the farm. Over long periods of time the average forest income ranks nearly as high as the average agricultural return. This fact is not apparent from year to year and is too frequently overlooked.

The ultimate goal in forest production is to keep the woods fully stocked with high grade trees and secure an annual or short periodic yield equivalent to the growth during such period. The forest investment will then lose the long wait between financial returns. The forest will thus resemble the bond investment on which the earning coupon is clipped each year. The earning coupon of the forest is the annual growth. Forest regulation, whereby the growth is harvested each year or short period of years for revenue, is the ultimate goal in scientific forestry practice.

Lumber values have increased many times during the past years. They will undoubtedly increase with rapidity as our virgin forests in the west become more inaccessible and eventually cease to flood our local eastern markets. It takes years to grow a mature forest. In the past immature forests have had little or no commercial attraction as an investment. As the virgin forests dwindle during the next forty years the partly-grown forest will have a definite value. One need not wait the entire rotation period to sell the young forest at its investment value.

WHERE TO OBTAIN FOREST SEEDLINGS

The Indiana Department of Conservation maintains a forest tree nursery at the Clark County State Forest, Henryville, Indiana. Visitors are always welcome.

At the present time hardwood seedlings are sold for $5.00 per thousand. Coniferous stock is sold for $10.00 per thousand. The trees are sold at a price not to exceed the cost of production. Orders are placed as they are received. All orders are accepted subject to having a sufficient supply available when the trees are actually dug. Orders should be placed early. Address all inquiries to the Division of Forestry, Indianapolis.

WHEN TO PLANT

The location of the State Nursery in southern Indiana makes it possible to ship trees very early in the spring. As soon as the frost has left the ground is the proper time to plant forest seedlings.

The planting season in Indiana begins any time after March 10 and continues with the uncertain spring weather until May 1.

The earlier the trees can be planted the better they will establish. They should not be planted except in their dormant winter condition before the buds have started to swell.

Trees can be supplied for fall planting but this is not advisable, because fall-planted trees are subject to winter killing and frost heaving.

PREPARATIONS OF THE PLANTING SITE

Under ordinary conditions it is unnecessary to plow or cultivate the site either before or after planting. Heavy sod should be plowed under the previous fall. If the entire area is not plowed, strips a few furrows wide can be turned under where the rows of trees are to be planted.

On extremely wet ground a back furrow can be thrown up where the rows are to come and the trees can be placed on the slight elevation. Where the trees are planted on old fields of weeds or stubble it is seldom necessary to treat the area before planting.

If the seedlings are planted in a brush thicket it will be necessary to keep the brush cut back until the trees are established. Seedlings planted in a woods should only be placed in the open places where some direct sunlight is available, otherwise they will grow slowly and may be killed outright by the shade.

CARE OF TREES UPON ARRIVAL

Notice will be sent to each purchaser a few days before the trees are packed and again when they are actually shipped. They should be planted immediately upon arrival. If they are planted direct from the shipping box, care should be taken to keep the roots covered with the wet straw or moss in the box. If the packing begins to dry out perceptibly, water should be sprinkled over it. The tops of the trees should be kept as dry as possible, for they will mold if kept too warm and damp.

Fig. 3

Fig. 3. A seedling bundle of pines as taken from the packing box upon arrival from the nursery.

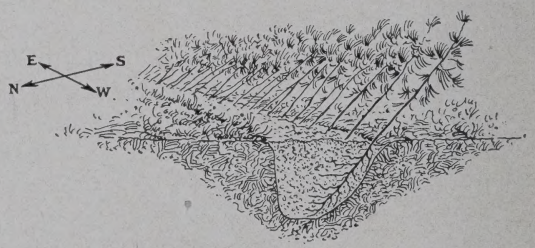

Fig. 4

Fig. 4. The bundle opened and heeled in a trench with the moist earth firmly packed about the roots of each seedling. Dig the trench east and west and slope the seedling tops toward the south to prevent the sun from scalding the tender stems.

If the trees cannot be planted at once, the trees should be removed from the box, the bundles should be cut, and the trees "heeled in." This

means placing the trees in a trench and firmly tamping moist fresh earth about the roots of each tree. If the bundles are not cut and the trees spread in the trench, air will penetrate the bundles and the seedlings in the center of them will dry out and die.

Keep the roots moist at all cost. This factor and the one of early planting in the spring are two important factors by which the success of your planting will be determined. Careful planting in the field is of equal importance.

PLANTING THE TREES

Trees require a certain amount of light and moist mineral soil about their roots. If either of these factors are too unfavorable, the trees grow slowly and may even perish. The trees should be planted a little deeper than they were grown in the nursery. Sod and litter should not be placed in contact with the roots. Moist mineral top-soil should be placed in the hole about the roots of the seedlings. The lumps of earth should be pulverized with the hand as the hole is filled.

If sod or litter is present, it should be scattered upon the ground at the base of the seedling after it has been planted to form a mulch to prevent baking or drying out by the sun during the hot, dry season. Unless the existing ground cover, such as high weeds, or heavy sod, is too unfavorable, it is unnecessary to plow it before planting.

Two methods of planting are common. Each planter may take a bucket in which the roots of the trees have been puddled in wet mud, sand or packed in moist litter, and a mattock or grub hoe, then go back and forth across the area digging holes and planting trees as he goes. Another method is to form two-men crews. One man goes ahead digging holes only while the second one follows to plant trees in the holes already dug. Each tree should be firmly tamped with the toe or heel after it has been planted.

SPACING

The usual spacing for tree planting is 6′x6′. The trees may be planted 4′x4′ or 8′x8′ according to the funds available for the work. The closer spacings favor earlier canopy cover for the ground and taller, cleaner boles. All of these are desirable. Only a certain number of the original trees will reach maturity even with the wider spacings.

Christmas trees should be planted 4′x4′ or not more than 5′x5′ apart.

Windbreak trees are best planted not more than 6′x6′ apart in rows. However, if the ornamental form is desired where each tree has ample space on all sides to develop branches to the ground, the trees may be 10 or 15 feet apart. In planting the rows, regardless of the spacing used, alternate the trees in each row with those of the adjacent row so every tree comes opposite a space in the adjoining row. This offers an impenetrable barrier to the wind. Plant the windbreak on the west and north side of the buildings and protect it from grazing animals.

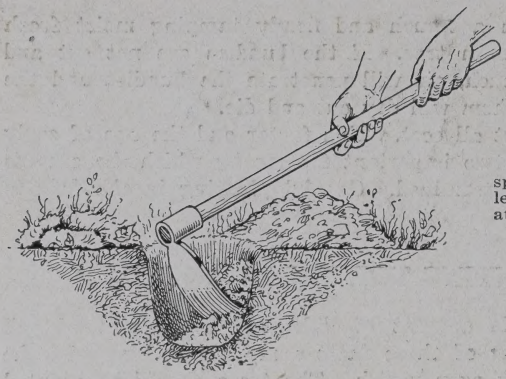

Fig. 5

Fig. 5. Hole dug with ample space for roots. Surface sod or leaves separated from mineral earth at the edge of the hole.

Fig. 6. The mineral earth should be crumbled evenly about the roots of the seedling. Do not cramp the roots.

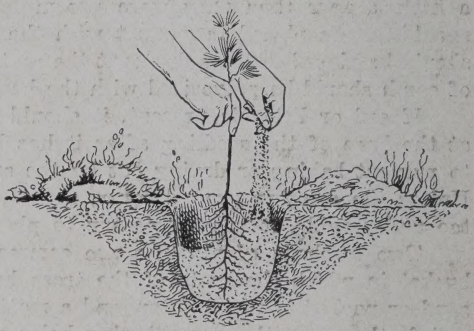

Fig. 6.

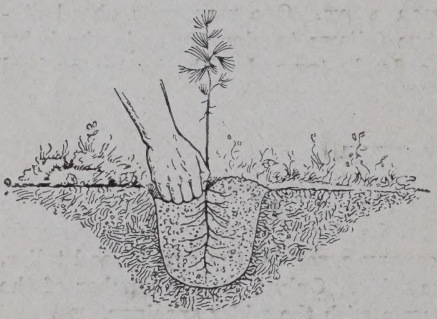

Fig. 7

Fig. 7. Pack the mineral earth down firmly before spreading the sod or leaf mulch over the ground surface.

Fig. 8. Distribute sod or leaf cover around the stem of the seedling and pack firmly with the toe. The planted seedling should be firm enough to resist several pounds pull.

Fig. 8

CARE OF THE TREES AFTER PLANTING

The young planting should be protected from fire, grazing animals, and so far as possible from insect and disease enemies.

If the trees are planted close to a railroad or to fields which may burn over, extreme vigilance should be exercised in the dry spring, summer, and fall seasons. Lanes can be kept open through the planting by trimming the trees and keeping the ground as clean from debris as possible. Furrows can be plowed to expose the mineral earth around the area or in the lanes. If fire should start it may be checked from this strip of bare ground by setting back-fire towards the oncoming flames. Small fires can be beaten out with a wet sack or broom.

Stock of any kind will browse on the young trees and injure their shape by rubbing and trampling them. Young plantings must be protected from cattle, hogs, and sheep.

If any injurious insect or fungous damage appears, the infected material should be removed and burned. Notify the Division of Forestry or Division of Entomology and send samples of the injury for examination.

TABLE 1

Purpose	Species	Spacing	Trees per Acre	[1]Cost of Trees	[2]Planting	[3]Total Cost per Acre
Timber	**Hardwoods—**					
	White oak	6′x6′	1,210	$6 05	$6 00	$12 05
	Red oak	6′x6′	1,210	6 05	6 00	12 05
	Tulip	6′x6′	1,210	6 05	6 00	12 05
	Walnut	8′x8′	680	3 40	3 37	6 77
	Maple	6′x6′	1,210	6 05	6 00	12 05
	Cottonwood	8′x8′	680	3 40	3 37	6 77
	Conifers—					
	White pine	Preferred for all species 5′x5′ or 6′x6′				
	Red pine					
	Shortleaf pine					
	Corsican pine		1,742	17 42	8 80	26 22
	Scotch pine		1,210	12 10	6 00	18 10
	Western yellow pine	Permissible for tax reduction Law—all species 8′x8′				
	Norway spruce					
	White spruce					
	European larch		680	6 80	3 37	10 17
Posts	White oak	6′x6′	1,210	6 05	6 00	12 05
	Red oak	6′x6′	1,210	6 05	6 00	12 05
	European larch	6′x6′	1,210	12 10	6 00	18 10
Wind-breaks	Norway spruce	(Best) 6′x6′	1,210	12 10	6 00	18 10
	White spruce	(Permissible)				
	(Same)	8′x8′	680	6 80	3 37	10 17
	(Same)	15′x15′	193	1 93	95	2 88
Christmas trees	Either	6′x6′	1,210	12 10	6 00	18 10
	Norway spruce	5′x5′	1,742	17 42	8 63	26 05
	or	4′x4′	2,722	27 22	13 49	40 71
	White spruce	3′x3′	4,840	48 40	24 00	72 40

[1]Based on a price of $5.00 per thousand for hardwoods and $10.00 for conifers.
[2]Based on two men planting 1,210 trees a day for $6.00.
[3]This does not include a small transportation charge from the nursery.

Fig. 9. Two men make a good planting crew. The man digging clears away surface litter before making the hole. A man follows and plants each tree from a bucket of mud or wet straw.

Fig. 10. A large planting crew at the Clark County State Forest, Henryville. Each man digging is followed by a man to plant the trees in his row. An extra man or boy drops the trees for the entire crew.

This "farmed out" old field was planted experimentally to ash and tulip in 1912. Experimental hardwood failures at the State Forest are being replanted to pine. The pines thrive on poor soils where our native hardwoods fail. The small pine in the left foreground is a native pine seedling three years old.

THE KIND OF TREES TO PLANT

There are two main groups of forest trees, the conifers, or evergreens, and the broadleaved hardwoods. The coniferous trees recommended for planting are the pines, spruces, and larches.[1] The hardwoods are the oaks, maples, tulip, walnut, sweet gum,[2] and the cottonwood.

Although tree species vary in their choice of soil and moisture requirements the hardwood group can be classed as trees suitable only for planting on soils of good agricultural fertility. The conifers will thrive equally as well on good soils but they also have the ability to thrive on poor soils, which are below agricultural fertility. Almost any species of pine will thrive on any soil in Indiana.

It is difficult to describe every soil in the state in terms which the average person can interpret. Each group of trees named will be discussed in terms which it is hoped will be easily understood. Planting advice will be gladly furnished by the Division of Forestry upon request. Each prospective tree planter is urged to confer with the Division of Forestry before making a choice of species.

THE HARDWOODS

The hardwood trees recommended for forest planting in Indiana are white, pin, cow, and red oaks, tulip, black walnut, sugar maple, sweet gum and cottonwood.

Artificial plantings of ash do not seem to thrive. The tree is attacked by a scale which retards the growth and frequently kills it.

On account of the locust borer, black locust plantings have been a failure in so many cases that it is a very doubtful tree to plant in Indiana for posts or timber. Locust is an excellent nurse crop for rebuilding eroded or worn out soil to the point where bluegrass pasture or native hardwood species will grow again.

Good Soil

By good soil is meant one which will grow a good corn crop now, or would do so if the area were cleared of existing forest growth.

The hardwoods named will grow on any Indiana soil which grew the beech, sugar, maple, ash, walnut, and tulip in various combinations as virgin forest. If it is a case of reinforcing with better species an area which now has on it this type of forest, the hardwoods named will make very satisfactory growth. If the area to be planted has been cleared of the original growth and has not been farmed out, it will grow any of the native Indiana hardwood trees.

Timber—For timber plant the oaks, walnut, tulip, sugar maple, chestnut, cottonwood, and sweet gum. The walnut and tulip grow more rapidly than the white oak, red oak, and sugar maple. The cottonwood, sweet gum, and pin oak should be used on low wet sites, specially those which are subjected to stream overflow. Under such conditions these

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[1] The larches belong to the conifer family but shed their needles in the fall.
[2] This is the liquidambar or red gum, and not the black or sour gum.

trees form our fastest growing forest type in Indiana. Cuttings of the cottonwood are generally used.

Fig. 11. Black walnut planting located one mile east of Milton, Ind. The planting is on excellent loam soil. The trees are about 25 years old. They vary from 6" to 15" in diameter at breast height. The average clear bole is 25 to 30 feet. The trees are spaced about 6'x8' apart.

Do not plant black walnut except on very fertile land. This is an exceedingly valuable tree to plant. It should be planted with an 8'x8' spacing if planted either pure or mixed with other species. It is rec-

ommended that this tree be planted in the open areas of woodland or along fences, and that the startified nuts should be planted instead of the one-year-old seedling trees.

Posts—For fence posts plant white oak and Osage orange.

Poor Soil

By poor soil is meant one which has either lost its native fertility by poor farming or erosion, or is too sandy or too sour and compact to grow a good crop of corn.

Black locust can be used on practically any soil in Indiana as a nurse crop. It is a member of the legume family which add nitrogen to the soil. Its destruction by the locust borer for timber will not impair its soil building quality. It will check erosion and improve the soil for the associate tree, which should be planted with it for timber. One should keep in mind the possibility of the locust borer when using this species.

Growing Your Own Hardwood Seedlings

The acorns and nuts of the heavy seeded hardwoods named—oak and walnut—may be planted instead of purchasing seedlings. Gather the seeds in the fall when mature and cover them about an inch or so deep in layers outdoors in a box or bed of sand or fine soil. They will germinate as soon as warm weather comes in the spring and must be planted (prior to germination) in the field as soon as the frost has left the ground. The seeds should be kept moist at all times. The above named species have long tap roots which make transplanting difficult. For this reason planting the seed in early spring direct to the field after they have been stratified over the winter has some advantages.

The seeds of ash, maple, and tulip are small and more difficult to grow to suitable sizes for planting. These species should be purchased from the State Nursery.

THE CONIFERS

The coniferous trees recommended for forest planting in Indiana are white pine, red or Norway pine, shortleaf pine, western yellow pine, jack (or Bank's) pine, Jersey pine, Scotch pine, Corsican pine, Norway spruce, white spruce, and European larch.

Although white pine, jack and Jersey pine are the only species named which occur native in Indiana, they will grow vigorously in the State. On poor fields they are the only species which will make satisfactory forest growth. All are evergreen except larch. They make fine windbreaks, bird havens, Christmas trees, and attractive forests.

Good Soil

On soil of average and better fertility any of the coniferous trees will flourish. It is advisable then to select for planting certain ones which will grow the fastest and make the most valuable products.

Timber—White pine is the most valuable one for lumber and is probably the fastest growing species. The wood is light, soft, work-

able, but not very durable, unless kept treated with paint or preservative. It is to be preferred on the better class of poor soils. This species will withstand a limited amount of shade.

Red (misnamed Norway) pine is next in preference to white pine. It has about the same utility characteristics but it will grow on poorer soils than the white pine. It will not thrive under shade.

Norway and white spruce are grown extensively for timber. They grow rather slowly for the first few years, especially if they are planted too deeply. They will withstand more shade than the other conifers.

Fig. 12. An eroded hill on a Jackson County farm. A neighbor stated that it was a fine peach orchard forty years ago. The pines are the proper species to plant on this type of land. A nurse crop of black locust planted with the pines would help to reclaim the area.

Posts—The European larch is a rapid growing species of fair durability, especially if treated with a preservative. It requires open sunlight to make satisfactory growth.

Windbreaks—Although any of the evergreen conifers afford a windbreak, the white pine, red pine, white and Norway spruces are the best species to use. They are quite ornamental and add many times their cost price to the value of a home.

Poor Soil

In speaking of poor soil with reference to planting conifers is meant the poorest sand or clay type of soil in Indiana. None of our soils are too poor to be outside this classification of pine land.

Timber—The red pine has been described with the good soil species. It seems to grow satisfactorily even on the poorest soils of the state. The western yellow and Corsican pines are recommended for lumber trees. The wood of these species is rather soft, workable, and suitable for general construction work where hardness is not essential.

The shortleaf, jack, Jersey, and Scotch pines will grow on the poorest soils. The wood is fairly hard, strong, and inclined to be resinous. It is suitable for such uses as cheap flooring, sheathing, railroad ties, and general construction work.

Posts—The European larch is the only coniferous species to be recommended for posts. It is an untried species in Indiana but it will without doubt grow on all except the poorly drained and heaviest soils.

Windbreaks—The white pine, white and Norway spruces make the most satisfactory trees for windbreaks.

Christmas Trees—The scarcity of native evergreens in Indiana and the fact that thousands of them are imported each holiday season makes feasible the commercial growing of Christmas trees. Norway and white spruces are the species to use. They should only be planted for this purpose on well drained soils of average or better fertility.

A spacing of 4′x4′ will require about 2,700 trees to the acre. In ten or twelve years at least 1,500 trees to the acre should be ready for market.

A rotation of ten years can be assumed and if twenty acres are devoted to this crop a two-acre plat could be planted each year. After about the tenth year an annual harvest could be made of two acres of trees.

The trees should not be planted in stiff sod. An occasional cultivation for the first year or two will benefit the trees by keeping the weeds down, but such cultivation is not essential.

PRODUCTION OF STATE FOREST NURSERY

	Trees Planted (Experiments)			/Trees Sold (Nursery)			
Year	Hardwoods	Evergreen	Total	Hardwoods	Evergreens	Total	Amount
1920.....	8,000	14,000	22,000				
1921.....	4,080	52,427	56,507	(Nurse	ry establish	ed in 1922)	
1922.....	7,216	4,225	11,441	13,000	.....	13,000	$55 15
1923.....	32,406	15,083	47,489	29,295	159	29,454	142 59
1924.....	3,294	10,750	14,044	54,206	2,000	56,206	180 89
1925.....	21,891	49	21,940	81,346	3,370	84,716	494 99
1926.....	18,075	60,449	78,524	85,500	51,700	137,200	956 75
1927.....	1,100	97,396	98,496	125,190	142,265	267,455	1,522 68
1928.....	7,950	67,092	75,042	180,860	289,360	470,220	3,947 85
1929.....	1,500	85,200	86,700	129,025	443,203	572,228	4,804 41
1930.....	69,600	104,425	174,025	196,050	361,000	557,050	4,218 00
1931.....	595,100	106,395	701,495	924,865	374,642	1,299,507	5,736 53
Total...	770,212	617,491	1,387,703	1,819,337	1,667,699	3,487,036	$22,059 84

Fig. 13. A splendid young spruce, pine and red cedar windbreak on the west side of the farm buildings of Mr. Daniel Stump, Cromwell, Indiana. A planting of this kind adds both beauty and value to a farm.

MIXED PLANTING COMBINATIONS

Planting Conditions	Major Species	Use	Associate Species	Use	Alternate Spacing in Row
Good Soils Land of good agricultural fertility	White or Red Oak	Timber	Larch	Posts—Poles	6′x6′
			Sugar maple	Timber—maple sugar	6′x6′
	Tulip (Yellow poplar	Timber	Red Oak	Posts—Poles	8′x8′
			Sugar Maple	Timber—maple sugar	8′x8′
			Black Locust	Nurse crop—posts	6′x6′ or 8′x8′
			Walnut	Timber	8′x8′
			White Oak	Timber	8′x8′
			White Pine	Timber	6′x6′ or 8′x8′
			Norway Spruce	Timber	6′x6′ or 8′x8′
			White Spruce	Timber	6′x6′ or 8′x8′
			European Larch	Posts—poles	6′x6′ or 8′x8′
	Black Walnut	Timber	Tulip	Timber	8′x8′
			White Pine	Timber	8′x8′
			Sugar Maple	Timber—maple sugar	8′x8′
			White or Norway Spruce	Timber	8′x8′
Poor Soils (Sands and clay) ridges. Farmed out, eroded, and sour soils. (These species will also apply to Good Soils.)	**Any of these**	**with**	**any of these**		
	Corsican Pine	Timber—windbreak	Black Locust	Nurse crop—posts	For these species 4′x4′ or 5′x5′ is best but 6′x6′ is customary
	American Red Pine	Timber—windbreak	Sugar Maple	Timber—maple sugar	
	Scotch Pine	Timber—windbreak	White Oak	Timber—posts	
			White Pine	Timber—windbreak	
	White Pine	Timber—windbreak	Norway Spruce	Timber—windbreak	
	Western Yellow Pine	Timber—windbreak	White Spruce	Timber—windbreak	
	Shortleaf Pine	Timber			
	European Larch	Timber			
	Jack Pine	Timber			
	Jersey Pine	Timber			
Overflow Land	Cottonwood	Timber	Cow Oak	Timber	6′x6′
			Pin Oak	Timber	6′x6′
			Sweet (or Red) Gum	Timber	6′x6′
Windbreaks or Christmas Trees	Norway Spruce		White Spruce		All 5′x5′ windbreak or 4′x4′ 5′x5′, 6′x6′ for Christmas Trees
			White Pine		
			American Red Pine		

Norway spruce transplants in the the state nursery for future Christmas trees, windbreaks and timber. (See next illustration).

Fig. 15. Norway spruce (16 years old). Demonstration windbreak and Christmas tree planting at the Clark County State Forest, Henryville, Ind.

MIXED PLANTINGS

Although pure plantings require less initial trouble in the actual plantings, it is generally advisable to mix two or more species. In doing this there is less chance of securing the wrong combination of species and site. In a mixed planting the more promising species can be selected to form the final crop and the less favorable ones removed as a thinning.

In selecting the correct combination of species the intolerant (light demanding) species of rapid height growth should be associated with the more tolerant (shade enduring) species of slower growth. In this way the intolerant trees can keep their thin crowns above the tolerant ones growing below the upper crown level.

The tolerant species such as sugar maple, white oak, Norway and white spruce, have thick crowns which permit little vegetation to grow beneath them. As they approach maturity under the overstory of intolerant species they will shade the side branches from them, leaving the long, clean boles of dominant trees.

The prevailing idea in all mixed plantings is to have a major and a minor species in order that a more complete utilization of site and products can be secured.

TAX CLASSIFICATION FOR FOREST LANDS

In 1921, the General Assembly of Indiana passed an act to encourage timber production and to protect water sheds by classifying certain lands as forest lands and prescribing a method of appraising lands thus classified for purposes of taxation.

Under the provisions of this law both native forest lands and forest plantations of three acres or more will be placed on the tax duplicate at an appraised value of one dollar an acre if the owner will agree to protect the forest from grazing. The law imposes no yield taxes, cutting rules, or other restrictions upon the owner .

Before the forest can be so classified it must be inspected by the State Forester. This service is rendered free of charge and offers an opportunity for the forest owner and State Forester to have a conference over the best manner of handling the forest. At the time of inspection the details of the forest tax law are explained. No obligations to classify are involved until the proper blanks have been legally completed.

Time and traveling are expensive. The forest owner must realize that classified land cannot be pastured and should be sincerely interested before asking for an inspection. Over five hundred classified forests have been established.

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Fig. 16. Probably the largest forest-grown oak tree in America. The tree is 7'1" in diameter at 4½ feet above the ground. The forestry problem is to reconstruct timber comparable to this on over 3,000,000 acres of cut-over land.

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Fig. 17. American red pine—8 years old. Demonstration planting on poor soil at the Clark County State Forest, Henryville, Ind.

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The Clark County State Forest of Indiana

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By

RALPH F. WILCOX

Acting State Forester

THE DEPARTMENT OF CONSERVATION

Division of Forestry

CHARLES C. DEAM
State Forester

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RICHARD LIEBER
Director

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The Clark County State Forest of Indiana

Location and Area

The Clark County State Forest of 4,487 acres is one-half mile northwest of Henryville. It lies chiefly in the northwest corner of Clark County with about 500 acres extending across the line into Scott County. The administration buildings and a small area west of them lie within the limits of the old Clark or Illinois grant.

The Pennsylvania railroad, Interstate traction, and concrete section of State Highway 31, all border the east line of the administration grounds. Local railroad trains and limited traction cars stop at Henryville. Local traction cars stop at the State Forest.

History

The State Forest was purchased as follows:

Year	*Area*	*Cost*
1903	2,028 acres	$16,000.00
1921	699 acres	8,038.00
1922	133 acres	1,454.00
1923	130 acres	650.00
1924	557 acres	4,456.00
1926	377 acres	4,420.00
1927	563 acres	7,110.00
Total ..... (1)	4,487 acres	$42,128.00

The Clark County State Forest was consolidated to a single unit by the purchase of numerous farms. Parts of these farms were cleared for agriculture in the more favorable portions, but little clearing was ever done in the rough "knob" region.

The State Forest land has all been cut over from time to time. It is now well stocked with thrifty second-growth hardwoods and pine. Most of the old abandoned fields have been planted for experiments or have been permitted to grow up again to forests.

Purpose

The original purposes of the state forest were to own and operate a state forest for forest research, and to profitably produce successive crops of timber on land which for the greater part is unsuited for agriculture.

Administration

The Clark County State Forest is operated by the Division of Forestry of the Department of Conservation. All technical forestry work on the State Forest is directed by the State Forester and his assistant,

(1) Area and cost is in even numbers. Final settlement for 1927 purchases is not complete.

Looking northeast from the fire tower at the State Forest.

whose office is in the State House at Indianapolis. The local personnel of the State Forest consists of a superintendent, assistant superintendent, a foreman, and local day labor. Written instructions are issued from the Division office, and when completed by the field personnel, are returned to the Division office for record. All experimental and cultural activities are recorded in detail with an itemized account of the labor and expense involved, and with the results of the experiment carefully noted for each particular tract under observation.

Policy

1. To operate the State Forest as a research laboratory for the scientific study of the trees and shrubs of Indiana.
2. To preserve in perpetuity a natural recreation place for the people of Indiana.
3. To grow forest tree seedlings for reforestation at a cost not exceeding that of production.
4. To grow and market successive crops of timber at a profit.

Activities

For the convenience of description, the activities at the Clark County State Forest may be divided into the following:

1. The forest.
2. Experimental research.
3. The nursery.
4. The arboretum.

RECEIPTS FROM CLARK COUNTY STATE FOREST

Products	1920	1921	1922	1923	1924	1925	1926	1927	Total
Cross ties	.....	$73.65	.....	$286.00	$1,376.70	$1,801.80	$22.05	$2,554.85	$6,115.05
Lumber	.....	1.00	.....	.....	110.10	42.57	44.49	17.16	216.32
Posts	$5.40	.....	.....	.....	.....	34.42	.....	3.75	43.57
Fuel Wood	45.75	94.00	$20.00	173.67	260.75	74.50	117.69	480.00	1,266.36
Miscellaneous	331.54	45.80	94.86	190.77	480.69	36.75	114.84	41.00	1,290.45
Total	$382.69	$214.45	$114.86	$650.44	$2,229.24	$1,990.04	$299.07	$3,096.76	$8,962.55

THE FOREST

Description

Approximately one-third of the forest area is gently rolling bottom lands between Henryville and the knobs to the west of it. The soil is a fine, heavy, light-colored clay, locally known as "crawfish" land. This soil is quickly exhausted of its fertility by agriculture and is very susceptible to erosion. For this reason a forest or farm cover should be constantly maintained.

The present forest is an all-aged stand of trees from seedlings to mature trees twenty-four inches in diameter. The forest contains a considerable amount of merchantable material such as white and black oaks, hickory and gum, which is suitable for ties and lumber. There are many mature pines which can be made into flooring, ceiling, sheathing and general construction lumber. Present plans include the purchase of a sawmill and logging equipment to utilize the mature timber in the forest at a profit to the state.

A selection system of cutting will be followed whereby only mature trees will be cut throughout the forest. A thrifty growing-stock of second growth will be left at all times to produce a succeeding crop of timber and protect the soil from erosion. The less valuable trees, such as the gum, hickory and black oaks, will be removed in favor of the faster growing, more desirable species such as tulip, white oak, ash and pine.

The other two-thirds of the forest lies in the "knobs" region where the topography is extremely rugged and abrupt. Sharp narrow ridges and ravines dissect the land, make agriculture impossible, and indelibly stamp the land "for forestry only". The evidence of this may be found on some of the broader knobs where an abandoned field (which once grew agricultural crops or fruit trees) is now growing pine. The hands which once cleared and tilled these old fields have left only the traces of their efforts. Forestry begins where agriculture ceases. It is our duty to see that each occupies the proper place in our economic welfare.

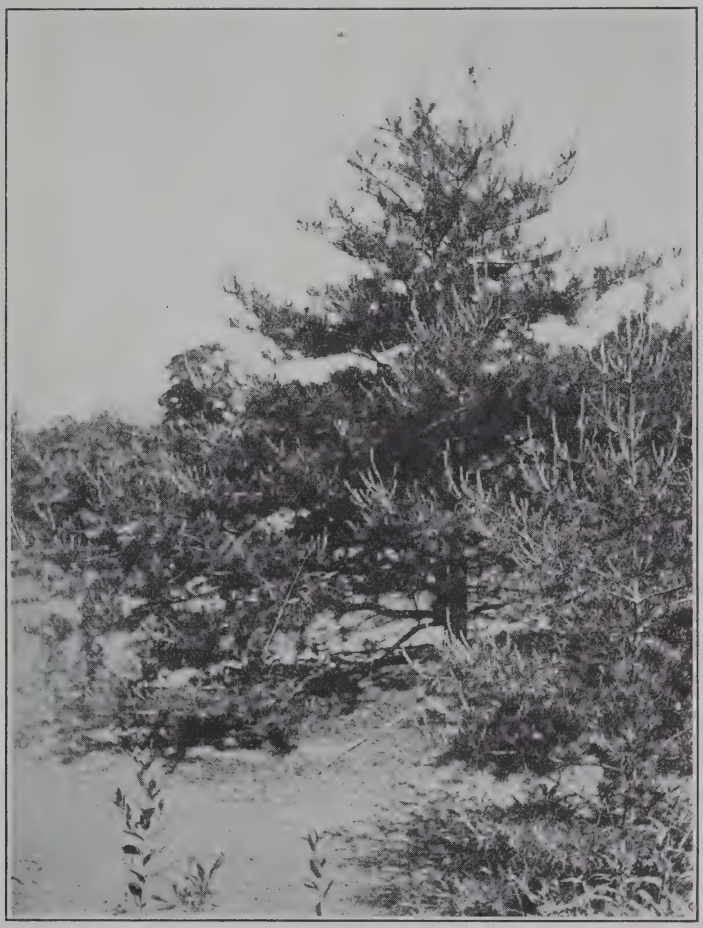
Geology

The geological formation underlying the State Forest is the knobstone of the Mississipian period, with the New Albany shales of the Devonian period lying underneath and outcropping in places at the bottoms of the ravines. The limestones of the "knobs" are abundant in fossils. Observing visitors who climb the "hill road" to the forest fire tower will find fascinating fossil specimens of animal history written millions of years ago on the rocky pages of time.

Forest Types

A forest is a group of trees which respond to the certain factors of climate and soil according to their respective habits of growth. Certain environments are therefore favorable to some trees and unfavorable to others. This may cause a forest community on one slope to be entirely different from the community on another and leads to the development of so-called forest types. Man has largely modified the

virgin forest types by logging, clearing or fire, even to the extent of changing them completely. An abandoned field may have originally grown a splendid forest of oaks, but may now be growing a crop of pines. The artificial forests which are established by man must conform to the soil and climatic requirements of the trees or they will fail. The study



Jersey pine sturdily reforesting an eroded field.

of such tree groups or types and their response to the soils and climate of Indiana is one of the major purposes and activities of the Forestry Division. This study is carried out to a large extent at the State Forest.

The Bottom Land Type

On the gently rolling slopes about the foot of the "knobs" and for a certain distance up the narrow ravines within them, will be found the

more exacting soil and moisture-loving species such as white, black, scarlet and red oaks, the sugar maple, beech, tulip, hickory and sweetgum. The greatest number of species is found in this type, for almost all trees will grow on moist fertile sites.

The largest trees are found in this type. The present forest ranges from four inches to twenty-four inches in diameter, depending on how recently the area has been cut over. In 1906-08, the entire state forest was cut over and thousands of feet of lumber and ties were sold.

Slope Type

This type is composed of the less exacting species, such as white and black hickories, scarlet, white, and chestnut oaks, chestnut and Jersey pine. The trees of the slope type have short boles and grow slower than those of the bottom land where growing conditions are more favorable.

Knob Type

The knob type is composed chiefly of chestnut oak, black oaks and Jersey pine. The Jersey, or "scrub" pine, merits a better name than "scrub", for it is an excellent mother tree to reforest old fields, steep slopes and ridges. It thrives and produces valuable timber on the high, dry ridges, where many other trees would not reach merchantable size. This type can be plainly identified by the green foliage of the pine, which invariably marks the highest point of the "knob" in the distance.

Old Field Type

This type is usually the Jersey pine whose prolific powers of reproduction soon reforest an abandoned field. The seeds of this tree seem to germinate and establish well on the bare mineral soils of a field, gully, or old woods road. For poor, "farmed out", and eroded fields this is one of our best trees and a wider use for this purpose is recommended throughout southern Indiana.

Forest Protection

At the present time there has not been a forest fire on the Clark County State Forest for twelve years. The forest is visited by thousands of people each year. It is bounded by private land owners who frequently cross the area, yet no fires have occurred during the period. This is a remarkable record. Neighbors to the State Forest and employes feel justly proud of their record. To have one single fire would change a remarkable record and might also destroy thousands of dollars' worth of timber, young trees and valuable experimental research plantings.

There are two fire towers on the State Forest. One is at the top of the "hill road" and is accessible by automobile. The other tower was erected by the United States government for geodetic survey work. From either tower a fine view can be had of the State Forest and the surrounding country. Both of these towers are about 1,000 feet above sea level, and about 500 feet above the surrounding country. On a

clear day, the countryside can be seen for a radius of twenty miles. Every visit to the State Forest should include a visit to one of these towers.

Fire Lanes

Many fire lanes are maintained throughout the forest in order to make fire fighting accessible and divide the forest into fire protection units of about fifty to one hundred acres. These lanes also permit the isolation of a fire to the particular area where it might originate. These fire lanes are about fifteen feet wide and are mowed each year. They are kept free from brush and other inflammable material.

Fire Fighting Equipment

The forest is equipped with fire rakes, torches for back-firing, water spray cans, axes and shovels. These tools are kept in readiness for fire day and night. The forest personnel respond to forest fire calls from the adjacent country. Wherever evidence of careless or malicious firing of the woods can be determined, the persons guilty are reported to the State Fire Marshal for legal prosecution.

A Game Refuge

The Clark County State Forest is practically all under forest cover, and makes a natural home for all kinds of wild life indigenous to southern Indiana. No hunting is permitted on the State Forest. As a result, many kinds of game such as pheasant, quail, rabbits and squirrels are abundant. This protection has increased the wild life on adjacent areas.

SCOTCH PINE PLANTATION—SIX YEARS OLD.
In fifty years this plantation should yield 15,000 board feet of lumber an acre.

Forestry in this country is a new art. As the needs for timber increase, the best methods of growing it should be studied. Indiana is a pioneer in this work and has the right to feel proud of the forest experiments being carried on at the State Forest.

Experimental Tracts

There are over one hundred recorded experimental plantings on the old fields and woodlands of the State Forest. Each year new experiments are started as the need for research develops. Experiments were started as early as 1904. Each demonstrates valuable lessons in the art of growing forest crops.

Many of the State Forest plantings are a failure in themselves, but as a scientific background for advising the Indiana timber grower, they are a valuable success. It is worth as much to know what not to do as it is to know what to do. Every year the Division of Forestry saves thousands of dollars for the Indiana tree grower from lessons learned at the State Forest laboratory. The State Forest research will develop in importance each year as the scope of forest tree planting widens in Indiana.

NOTE: A complete "Guide to the Clark County State Forest," by Chas. C. Deam, State Forester, is available for free distribution—The Department of Conservation, Bulletin 6, Publication 36, 1923.

NURSERY

Pine seed beds covered to conserve adequate moisture and prevent the soil surface from forming a hard crust, prior to germination.

In 1922, a forest tree nursery was established at the State Forest to supply the planting needs of Indiana forest owners at a nominal cost. These tree seedlings are grown on state land by the regular state forest personnel. They are sold at a price not to exceed the cost of production.

Capacity

Since 1922, the state forest nursery has furnished about a million forest tree seedlings. The demand for trees increases each year.

The present state forest nursery is inadequate and unsuited for permanent expansion. A new site of eleven acres has been selected along

the concrete road one-half mile north of Henryville. The area has been improved by tile drainage and a permanent water supply system will be installed. A packing and sorting shed will also be erected.

Future Requirements

The sale demand at the state forest nursery increased over each preceding year as follows: 1924—90 per cent, 1925—50 per cent, 1926—62 per cent. At the present rate of cutting in Indiana, it is estimated that the state would be treeless in twenty years. Of course such a condition is unthinkable and will never actually occur, for tree planting and tree preservation will increase while cutting decreases. The result will be a sustained balance between growth and utilization. It is estimated that the demand on the state nursery for forest seedlings will soon reach a million seedlings a year. The new nursery site will be able to furnish this number of trees.

STATE FOREST

Trees Planted (Experiments)				Trees Sold (Nursery)			
Year	Hardwoods	Evergreen	Total	Hardwoods	Evergreens	Total	Amount
1920	8,000	14,000	22,000				
1921	4,080	52,427	56,507	(Nurse	ry establish	ed in 1922)	
1922	7,216	4,225	11,441	13,000	.....	13,000	$55 15
1923	32,406	15,083	47,489	29,295	159	29,454	142 59
1924	3,294	10,750	14,044	54,206	2,000	56,206	180 89
1925	21,891	49	21,940	81,346	3,370	84,716	494 99
1926	18,075	60,449	78,524	85,500	51,700	137,200	956 75
1927	1,100	97,396	98,496	125,190	142,265	267,455	1,522 68
Total....	96,062	254,379	350,441	388,537	199,494	588,031	$3,353 05

Trees sold and planted at the State Forest	938,472
Trees planted at Brown County Game Preserve	12,000
Trees planted at Dunes State Park	20,000
Trees planted at McCormick's Creek State Park	20,000
Trees planted by State Highway Commission	3,000
Trees planted and sold since 1920	993,472

Methods

To grow a wide variety of young forest seedlings in large numbers and get them from seed to the planted trees without interrupting their natural life process, is an art. Trees are living things and growth never stops even in the apparently dormant dry seed. A few methods will illustrate the general manner of treatment. Methods which most closely follow nature are usually the best ones.

Seeds exotic to Clark County are purchased from commercial seed companies. Such local trees as tulip, the oaks, pines, sweet gum and chestnut are usually gathered from the trees growing on the State Forest.

Walnut seedlings in June, three months after planting the nuts.

Shaded beds of one-year-old white pine.

Storing the Seed

Many of the evergreens by habit do not disseminate their seeds in the fall, but rather throughout the winter and early spring. The seed of these trees can be kept in dry cold storage over the winter and planted in the spring.

The seed of such hardwoods as oak, walnut, chestnut, tulip, and ash naturally drop in the fall and lie under the wet leaves and snow until the following spring before they germinate. The seed of these trees should be either planted in the fall or else stratified in moist sand until spring. They must be planted the following spring without being allowed to dry out.

Planting the Seed

If space is available, the large-seeded hardwoods, such as the oaks, walnuts and chestnuts, are most conveniently sown in drills or rows wide enough apart to permit cultivation between the rows. The seed are put two or three inches apart in the drill and covered with two or three inches of earth.

The small seeded hardwoods such as tulip, ash, maple and elm, and the tiny evergreen seeds (often 35,000 to 65,000 seeds to the pound) are best sown broadcast or in narrow drills about four inches apart in the spring of the year in especially prepared beds. The beds are usually made of boards eight to ten inches wide and nailed to make a box frame. This frame can be made any convenient length and should be about four feet wide. This makes a convenient width for weeding. The beds are spaded and then raked to an even surface of fine earth. The proper amount of seeds then are sown broadcast or in drill rows and covered from a half inch to an inch deep with sand or fine earth sifted evenly over the seed. The beds are then covered with a mulch of leaves or straw and covered with paper or burlap. This covering prevents the ground from baking too hard for the tiny seedlings to burst through and insures an even moisture supply. Germinating seeds will die if they are permitted to dry out.

Care of the Seedlings

As soon as germination begins, the straw and paper must be removed from the beds and an artificial shade be provided for most species during the first season. Rodents, birds and diseases such as "damping off" must be controlled or the little seedlings may be destroyed. During hot dry weather the beds should be watered at night and shaded during the day. In warm damp weather the shade should be removed to permit aeration. This is done to prevent "damping off", a soil fungus which often destroys entire seed beds. The beds must be weeded and otherwise cared for.

Shipping the Seedlings

Shipping may be done either in the spring or fall, but spring is preferred. The seedlings are dug, and counted into bundles. They are packed with moist straw or moss into shipping boxes or containers. It is essential that the roots are not injured in digging or packing,

nor be permitted to dry out. The trees are shipped to their destination by express and should be heeled in upon arrival until planted. "Heeling in" consists of untying the bundles and spreading the trees out in a trench so their roots can be covered with moist earth firmly packed about them. It is essential that the roots be kept moist until ready for planting.

Planting the Trees

Trees require a certain amount of light and moist mineral soil about their roots. If either of these factors are too unfavorable, the trees grow slowly and may even perish. The trees should be planted a little deeper than they were grown in the nursery. Sod and litter should not be placed in contact with the roots. Moist mineral soil should be placed in the hole about the roots of the seedlings. If sod or litter is present, it should be scattered over the ground surface to form a mulch to prevent baking or drying out by the sun during the hot dry season. Unless the existing ground cover, such as high weeds, or heavy sod, is too unfavorable, it is unnecessary to plough it before planting.

Two methods of planting are common. Each planter may take a pail in which the roots of the trees have been puddled in wet mud, sand or packed in moist litter, and a mattock or grub hoe, then go back and forth across the area digging holes and planting trees as he goes. Another method is to form two-men crews. One man goes ahead digging holes only, while the second one follows to plant trees in the holes already dug.

Spacings

The usual spacing for tree planting is six by six feet. They may be planted four by four feet, eight by eight feet or ten by ten feet, according to the funds available for the work. The closer spacings favor earlier canopy cover for the ground, and taller, cleaner boles. All of these are desirable. Only a certain number of the original trees will reach maturity even with the wider spacings.

Spacing	*Approximate number of trees per acre*	*Relative labor cost per acre* (1)
4′x4′	2,700	$16.20
5′x5′	1,750	10.50
6′x6′	1,200	7.20
7′x7′	890	5.34
8′x8′	680	4.08

Ordering Trees

A list of trees available for distribution may be obtained from the Division of Forestry, the Department of Conservation, Indianapolis. The trees should be ordered from one to twelve months in advance of the shipping season, which usually comes in April. Orders will be received and filled as late as stock is available and the growing season will permit it to be shipped.

(1) Based on two men planting a total of 1,000 trees a day at a cost of $6.00.

Planting Regulations

Trees purchased from the State Forest Nursery at Henryville must not be re-sold. They should be protected from grazing and fire after they are planted. These trees are to be used for forestry purposes. Orders for less than one hundred trees are not desired.

Trees generally available for distribution and suitable for planting in Indiana.

Species	[1]*Soil and Moisture Requirements*	[1]*Tolerance of Shade*
Conifers:		
Austrian pine	Very moderate	Intolerant
European larch	Moderate	"
Jack pine	Very moderate	"
Japanese larch	Moderate	"
Jersey pine	Very moderate	"
Norway spruce	Moderate	Very tolerant
Red cedar	"	Semi-tolerant
Red (or Norway) pine	Very moderate	Intolerant
Scotch pine	" "	"
Shortleaf pine	" "	"
Western yellow pine	" "	"
White pine	Moderate	Semi-tolerant
Hardwoods.		
Black locust	Very moderate	Intolerant
Black walnut	" exacting	"
Chestnut oak	Moderate	"
Chestnut	Very moderate	Semi-tolerant
Red Oak	Moderate	" "
Sugar maple	"	Very tolerant
Tulip	Very exacting	Intolerant
White ash	" "	"
White oak	Moderate	Tolerant

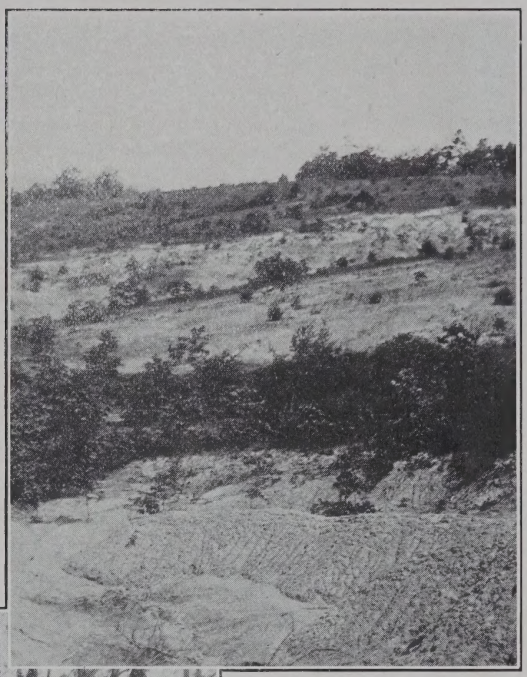
[1] "Moderate" is used to denote fairly fertile soil with a medium degree of available moisture in it. "Exacting" is used to denote a good fertile soil, well drained, with plenty of moisture available. "Tolerant" denotes the ability to grow under fairly shady conditions. "Intolerant" denotes a necessity on the part of the tree to have almost direct sunlight on its crown.

THE ARBORETUM

At the State Forest, Indiana has one of the best arboretums in this section of the United States. The forest administration building is on a prominent knoll west of state highway No. 31. Between this building and the highway are seven acres of sloping green lawn on which nearly two hundred trees and shrubs, native and exotic to Indiana, are planted. The specimens have been arranged for scientific study and landscape effect. Wherever practicable, the species are grouped according to genera to facilitate study. Each species is labeled with both common and scientific names and its native range.

The grounds are very attractive during the entire spring, summer and fall seasons, for invariably some of the specimens will be in full bloom.

Arboretum, from the porch of the administration building.



Idle acres or—

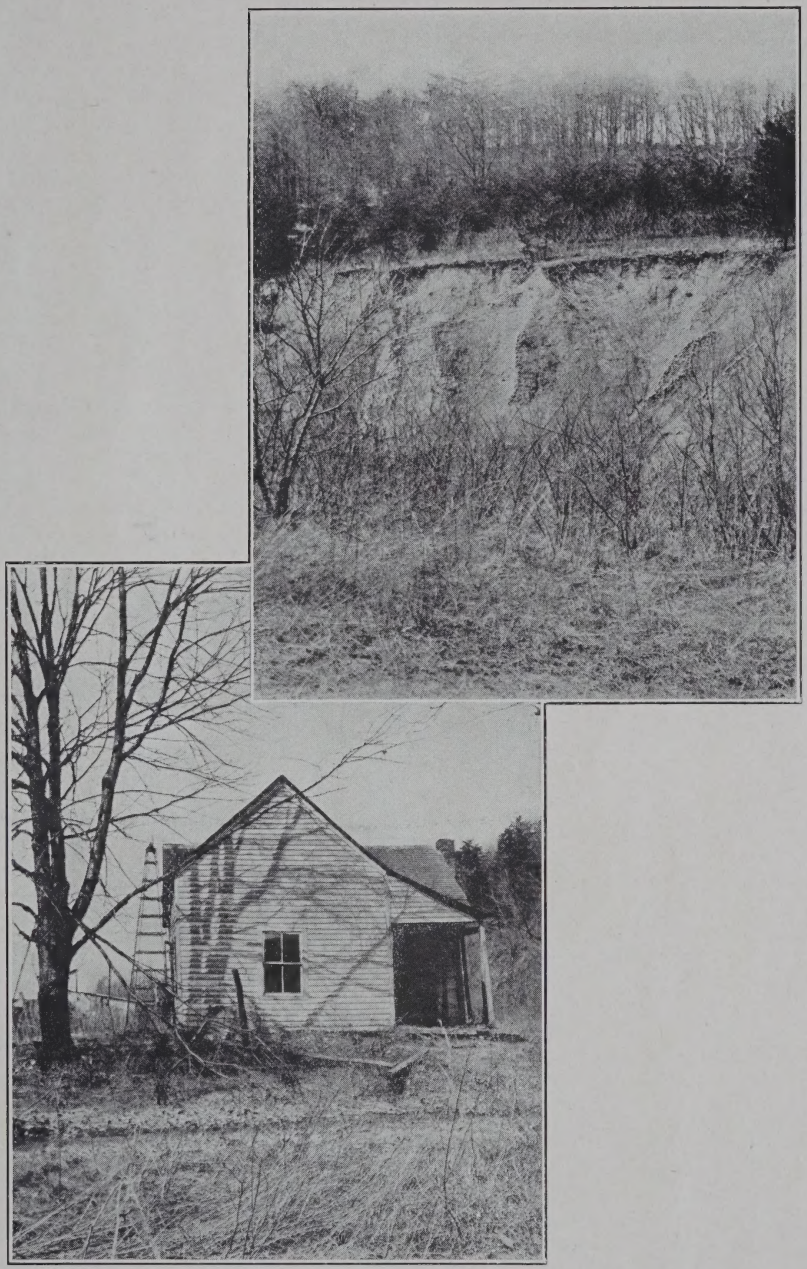
timber like this.

MORE STATE FORESTS NEEDED

The policy increases for public ownership and control of our natural resources. They are the birthright of all past, present and future generations. Our vast timber resource has been exploited by private ownership. The people of our land are themselves responsible for the shortsighted manner in which our forests have been cut, burned and wasted with little or no provision for a second crop. The task of renewing this valuable resource falls individually upon the citizens of each state and collectively upon the entire nation.

Indiana stands high among the states in good roads, schools and public wealth, but in forestry appropriation Indiana ranks twenty-ninth, and in ownership of state land it ranks sixteenth. In southern Indiana there are thousands of acres of land suitable only for the production of timber. It should be purchased, protected and developed to a profitable forest business.

It was the virgin timber resource which gave the first generation in Indiana the wealth to build homes, railroads and industrial enterprise. It will be the future timber resource which will utilize and make productive Indiana soil otherwise unproductive, and provide the people of the state timber, water, recreation and a high standard of living. The work of conservation, which is being carried out by the Department of Conservation, depends upon public support. The people of Indiana are urged to feel the responsibility of supporting all the phases of this important work.



Agriculture, or Forestry?

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